

510.05. METHOD OF MEASUREMENT.

The *retaining walls* and *sound barrier walls* will be measured for payment by the accepted area of wall as measured from the top of the footing to the top of the wall.

Items used in wall construction including, but not limited to, excavation, backfill, backfill material, concrete, reinforcing steel, form liners, perforated pipe underdrain, geocomposites, filter fabric, pipe underdrain cover material, concrete surface finish, and sheeting and shoring, will not be measured for payment. Include the cost of these unmeasured items in the price bid for wall construction.

Drilled shafts and piling will be measured and paid for as specified for drilled shaft and piling pay items.

Sloped wall will be measured by the surface area of completed sloped wall, according to the dimensions shown on the plans or required by the Engineer.

510.06. BASIS OF PAYMENT.

Accepted quantities of retaining wall, sound barrier wall, and sloped wall will be paid for at the contract unit price for:

- (A) RETAINING WALL SQUARE YARD (SQUARE METER)
- (B) SOUND BARRIER WALL SQUARE YARD (SQUARE METER)
- (C) SLOPED WALL SQUARE YARD (SQUARE METER)

which will be full compensation for all labor, material, equipment, and incidentals necessary to complete the respective work.

SECTION 511

REINFORCING STEEL FOR STRUCTURES

511.01. DESCRIPTION.

This work consists of furnishing and placing reinforcing steel in accordance with the contract documents. Reinforcing steel consists of deformed bars, epoxy coated deformed bars, and cold drawn wire mesh as specified.

511.02. MATERIALS.

- (a) **General.** Reinforcing steel shall meet the requirements of Section 723, except the strength requirement shall conform to grade 60 (420) unless otherwise specified in the special provisions or plans. Furnish cold drawn wire for spiral ties and other reinforcing designated in W (wire) sizes.
- (b) **Bar Lists and Bending Diagrams.** The bar list and bending diagrams shown in the contract documents are provided for estimating quantities. Bent bars are dimensioned out-to-out. Verify the quantity, size and shape of the bar reinforcement against the structure drawings and make necessary corrections before ordering.

If detailed bar lists and bending diagrams are not provided, submit such lists and diagrams for approval according to Subsection 105.02. Do not fabricate before the lists and diagrams

are approved. Do not fabricate vertical reinforcement in columns, walls, and piers until footing elevations are established in the field.

(c) **Fabrication.**

1. *Bending.* Fabricate reinforcing bars according to ACI 318 (318M) “*Building Code Requirements for Structural Concrete.*” Cold bend all reinforcing bars that require bending, unless otherwise permitted. If the Engineer allows heating for field bending reinforcing bars, take precautions to assure that the physical properties of the steel will not be materially altered. Do not bend bars partially embedded in concrete except as shown on the contract drawings or otherwise permitted.
2. *Hook and Bend Dimensions.* When the dimensions of hooks or the diameter of bends are not shown, provide standard hooks conforming to ACI 318 (ACI 318 M) .
3. *Identification.* Ship bar reinforcement in standard bundles, tagged and marked according to CRSI “*Manual of Standard Practice.*”

511.04. CONSTRUCTION METHODS.

(a) **Protection of Material.**

1. *General.* Store reinforcing steel above the ground on platforms, skids, or other supports. Protect from physical damage, rust, and other surface deterioration.

Use reinforcing steel only when the surface is clean and the minimum dimensions, cross-sectional area, and tensile properties conform to the physical requirements for the size and grade of steel specified. Do not use reinforcing steel that is cracked, laminated, or is covered with dirt, rust, loose scale, paint, grease, oil, or other deleterious material. Thin powdery rust and tight rust that does not reduce the effective cross section is not considered detrimental and need not be removed.

2. *Epoxy Coated Reinforcing.* Support coated bars on padded contact areas. Pad all bundled bands. Lift with a strong back, multiple supports, or a platform bridge. Prevent bar to bar abrasion. Do not drop or drag bundles.

Before placement, inspect coated bars for damage to the coating. Patch all defects in the coating that are discernable to the unaided eye with a prequalified patching/repair material according to AASHTO M 284. Clean areas to be patched by removing all surface contaminants and damaged coating. Roughen the area to be patched before applying the patching material. Where rust is present, remove the rust by blast cleaning or power tool cleaning immediately before applying the patching material.

Promptly treat the bar according to the resin manufacturer’s recommendations and before detrimental oxidation occurs. Overlap the patching material onto the original coating for 2 inches (50mm) or as recommended by the manufacturer. Provide a minimum 8 mil (200mm) dry film thickness on the patched areas.

Take necessary steps to minimize damage to the epoxy coating of installed bars. Clean and patch any damage to the coating noted after installation as described above.

Field repairs will not be allowed on bars that have severely damaged coatings. Replace bars with severely damaged coatings. A severely damaged coating is defined as a coating with a total damaged area in any 18-inch (450mm) length of bar that exceeds 5% of the

surface area of that portion of the bar. Coat mechanical splices after splice installation according to AASHTO M 284 for patching damaged epoxy coatings.

(b) **Placing and Fastening.**

1. *General.* Accurately place reinforcing steel in the position specified by the contract documents. Keep the reinforcing steel firmly held in place using approved supports while placing of concrete. Do not spot weld reinforcing steel.

Measure the spacing of parallel bars from center to center. For circular cages, measure on the curve where applicable. Measure the distance from face of concrete to reinforcing steel as clear distance.

Space parallel bars, center to center, at least $2\frac{1}{2}$ times the bar diameter apart, but not closer than $1\frac{1}{2}$ times the maximum nominal size of the concrete coarse aggregate plus one bar diameter.

Measuring perpendicular to the nearest concrete surface, place reinforcing steel within $\frac{1}{4}$ inch (6mm) of the plan location for bridge decks, and for slabs and walls less than 12 inches (300mm) thick; place reinforcing steel within $\frac{1}{2}$ inch (12mm) of plan location for all other structures. Provide 2 inches (50mm) clear cover for all reinforcement except as otherwise specified. For structure elements in direct contact with the ground, such as footings, abutments, retaining walls, and piers, provide 3 inches (75mm) clear cover.

Space parallel bars within $1\frac{1}{2}$ inches (40mm) of the required location. Do not cumulate spacing variations. The average of any two adjacent spaces shall not exceed the required spacing.

For mats and cages, tie reinforcing bars at all intersections except where spacing is less than 12 inches (300mm) in both directions, in which case alternate intersections may be tied. Tie all intersections around the perimeter of a mat. Tie all intersections of the last stirrup, hoop, or complete turn of a spiral at both ends of a cage.

Tie bundle bars together at intervals not exceeding 6 feet (2m). Do not bundle bars unless the location and splice details are specified. Use plastic-coated ties for tying epoxy coated bars.

Do not place concrete until the placement of the reinforcement is approved.

2. *Support System.* Support reinforcing steel in its proper position by use of mortar blocks, wire bar supports, supplementary bars or other approved devices. Use supports of such size and placed at sufficiently frequent intervals to maintain bar position within tolerances. Space slab bar supports no more than 4 feet (1.2m) apart transversely or longitudinally. Do not use reinforcing steel or bar supports to carry platforms for workers and equipment.

Use approved supports only.

3. *Mortar Blocks.* When using mortar blocks, use mortar blocks having compressive strength not less than that of the concrete in which they are to be embedded. Make the face of the blocks in contact with the forms no more than 2 inches (50mm) by 2 inches (50mm) in size. Use blocks having the same color and texture to match the concrete to be cast. Attach concrete block supports to the supported bar with 14 gage (2mm) wire cast in the center of each block. Use plastic or epoxy-coated wire when supporting epoxy coated reinforcing.

4. *Wire Supports.* When using wire supports, use ferrous metal chairs and bolsters complying with industry practice described in the “*Manual of Standard Practice of the Concrete Reinforcing Steel Institute.*” Use Class 1 (plastic protected), Class 1A (epoxy-coated), or Class 2, Type B (stainless steel protected) metal supports in contact with exposed concrete surfaces. Use stainless steel conforming to ASTM A 493, Type 430. Coat chairs, tie wires, and other devices used to support, position, or fasten epoxy coated reinforcement with a dielectric material. Do not use plastic supports.

(c) **Splices.**

1. *General.* Furnish all reinforcement in the full lengths specified. Except splices specified in the contract documents and splices of No. 4 (No. 13) or smaller bars, splicing will not be permitted without written approval.
2. *Lapped Splices.* Provide lap lengths shown on the plans. Splice reinforcing bars only where shown on the contract drawings or approved drawings. Stagger splices when possible. Do not place slab bar mechanical splices next to each other. Make lapped splices by placing the reinforcing bars in contact and wiring them together to maintain the alignment and position of the bars. Do not lap splice bars larger than No. 11 (No. 36) bars; use approved welded or mechanical splices.

3. *Welded Splices.* Use welded splices only if welding of reinforcing steel is detailed in the contract documents, or authorized. If welding is allowed, conform to AWS D 1.4.

Use welders that are currently certified. When required in the contract documents, test each weld using magnetic particle, radiography, or other nondestructive inspection techniques.

4. *Mechanical Splices.* Mechanical couplers may be used if specified or approved. Use approved couplers with a strength that is at least 125% of the required yield strength of the reinforcing steel.

When requested, remove and test two coupler splices out of each 100 installed, to verify coupler splice capacity. The Engineer will randomly select the splices to be tested.

5. *Splicing of Mesh.* If welded wire fabric is shipped in rolls, straighten into flat sheets before placing. Splice sheets of mesh or bar mat reinforcement by overlapping not less than one mesh width plus 2 inches (50mm) . Securely fasten at the ends and edges.

511.05. METHOD OF MEASUREMENT.

Reinforcing steel incorporated in the concrete will measured in pounds (kilograms) based on the total computed weight (mass) for the sizes and lengths of bars, wire or welded wire fabric shown on the contract drawings or authorized for use in the work.

The weight (mass) of reinforcing bars, plain or epoxy-coated, will be computed using Table 511-1. The weight (mass) of reinforcing wire, welded wire fabric, and plain bar of sizes other than those listed in Table 511-1, will be computed from tables of weights (masses) published in the AASHTO material specifications for those items.

The weight (mass) of reinforcement used in items, such as railings or precast members, where payment for the reinforcement is included in the contract price for the item, will not be included. Threaded bars or dowels placed after the installation of precast members in the work and used to attach such members to cast-in-place concrete will be included, if not included in structural steel. No

allowance will be made for clips, wire, separators, wire chairs, and other material used in fastening the reinforcement in place. If bars are substituted upon the Contractor's request and as a result more steel is used than specified, only the amount specified will be included.

The additional steel required for splices that are not shown on the contract drawings but are authorized, will not be included.

No allowance will be made for the weight of epoxy coating in computing the weight (mass) of epoxy-coated reinforcing steel.

Table 511-1
Reinforcing Bar Weights

Bar Designation, No.	Nominal Weight, lb/ft
3	0.376
4	0.668
5	1.043
6	1.502
7	2.044
8	2.670
9	3.400
10	4.303
11	5.313
14	7.650
18	13.600

Table 511-1
Reinforcing Bar Masses (Metric)

Bar Designation, No.	Nominal Mass, kg/m
10	0.560
13	0.994
16	1.552
19	2.235
22	3.042
25	3.973
29	5.060
32	6.404
36	7.907
43	11.380
57	20.240

511.06. BASIS OF PAYMENT.

The accepted quantities of each class of reinforcement, measured as specified in this Section, will be paid at the contract price per unit of measurement for the pay items listed below that are shown in the Plan bid schedule. Payment will be full compensation for the respective work prescribed in this Section.

- (A) REINFORCING STEEL POUND (KILOGRAM)
 (B) EPOXY COATED REINFORCING STEEL POUND (KILOGRAM)